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EXPERIMENT 2

AIM To determine the volume of a given metallic sphere with a vernier callipers with appropriate significant figures and verify the result using a graduated cylinder.

APPARATUS

A vernier callipers, metallic sphere, thread, graduated cylinder and water

THEORY

Let 'D' be the diameter of the sphere

$$r = \frac{D}{2}$$

Volume of sphere, $= \frac{4}{3} \pi r^3$

$$= \frac{4}{3} \pi \left(\frac{D}{2}\right)^3$$

D can be determined using a vernier callipers

Procedure

1. Vernier constant: Calculate the vernier constant of the vernier callipers as explained in section 2.3
2. Zero error: Press the two jaws A & B together till they both touch each other. If zero of the vernier coincides with zero of main scale, there is no zero error.

   If the two zeros do not coincides, note the division on vernier scale which coincides with any of the division on main scale. Multiply this number

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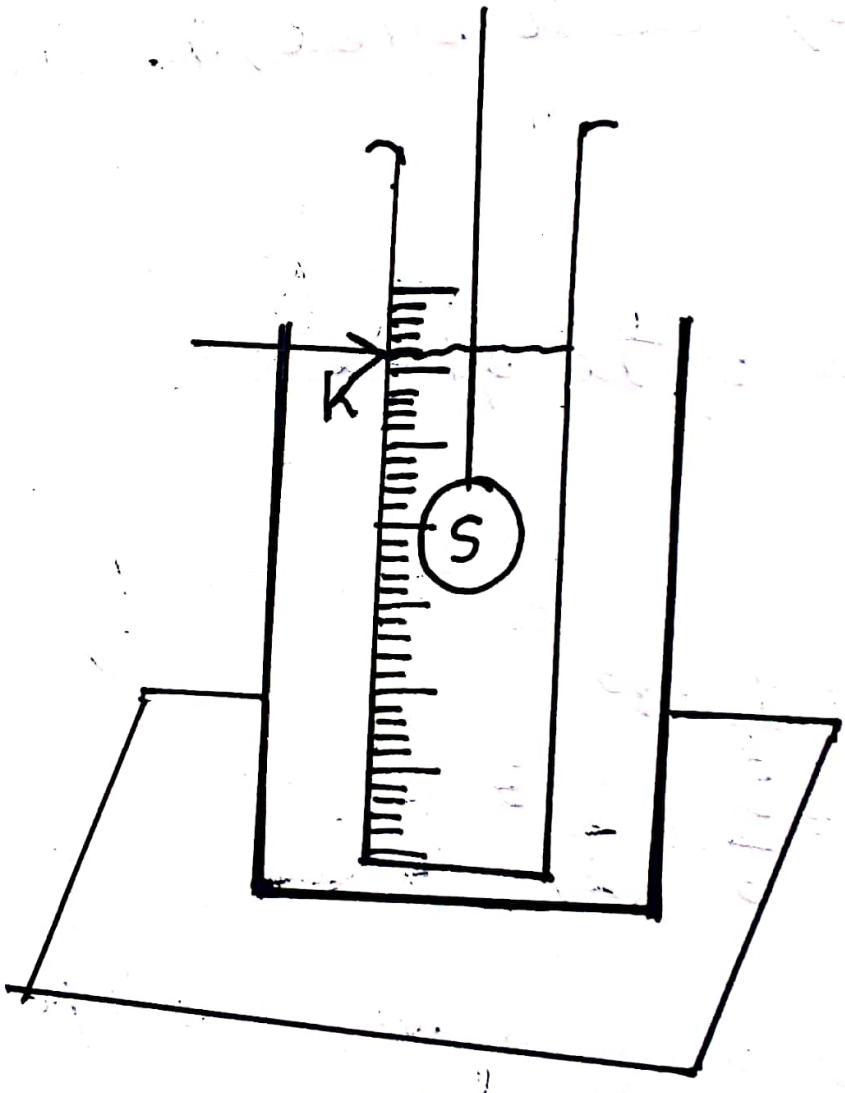

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by vernier constant. This gives the zero error of the instrument. Let it be 'a'. Zero error = $\pm a \times V.C$.

Positive sign is to be selected if the zero of the vernier is situated towards right of zero of main scale while the negative sign is to be selected if the zero of vernier scale is situated towards the left of zero of MS.

3) To find diameter of the sphere.

i) Hold the sphere in between two jaws A and B such that the jaws just touch the curved surface.

ii) Note the reading of main scale just before the zero of vernier scale. Let it be x

iii) Note the number of vernier division which coincides with any of the main scale division. Let it be y.

iv) Calculate the diameter using the formula $D = (x + y \times V.C)$ cm.

4) Volume

Calculate the volume of ~~cylinder~~ sphere by using formula $V = \frac{4}{3}\pi\left(\frac{D}{2}\right)^3$

5) Verification

Take some water in the graduated cylinder and place it on a horizontal table. Note the level of water in the cylinder. Suspend the metallic cylinder with a fine thread and lower it gently, into the cylinder, till it is completely immersed in water. Due to displacement of water by the metallic cylinder, the level of water in the graduated cylinder gets raised up. Note the final level of water. Difference of initial & final levels gives the volume of metallic cylinder. If this value tallies with that calculated above, the result is verified.

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RECORD

Vernier constant $1 S.D = 0.1 cm$

$10 V.D = 9 S.D$

$1 V.D = \frac{9}{10}$

Vernier constant $= 1SD - 1V.D = 1SD - \frac{9}{10} S.D$

$= \frac{1}{10} S.D = \frac{1}{10} \times 1 cm = 0.1 cm$

Zero error = ± cm.

	Serial no.	Main Scale Reading	Coincidence of Vernier Constant	Magnitude $x + y \times V.C$ (cm)	observed (cm)	Mean corrected (cm)
1.	i)	2.3	6	$2.3 + (6 \times 0.01)$	2.36	2.40
	ii)	2.4	4	$2.4 + (4 \times 0.01)$	2.44	
2.	i)	2.4	4	$2.4 + (4 \times 0.01)$	2.44	2.405
	ii)	2.3	7	$2.3 + (7 \times 0.01)$	2.37	
3.	i)	2.4	4	$2.4 + (4 \times 0.01)$	2.44	2.44
	ii)	2.4	4	$2.4 + (4 \times 0.01)$	2.44	

Note - In the chart for diameter reading i(i) and (ii) mean two readings taken at same place in mutually perpendicular direction

CALCULATIONS

Mean corrected diameter of cylinder $D = 2.415 cm = \frac{4}{3} \pi \left(\frac{2.415}{2}\right)^3$

Volume $V = \frac{4}{3} \pi \left(\frac{D}{2}\right)^3 = 7.37 \ cm^3$ (correct upto 2 decimal places)

VERIFICATION

Initial reading of water level in graduated cylinder $a = 50 \ cm^3$

Initial reading of water level in graduated cylinder $b = 60 \ cm^3$

Volume of metallic cylinder $= V' = b - a = 10 \ cm^3$

Difference $= V - V' = 2.63 \ cm^3$

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